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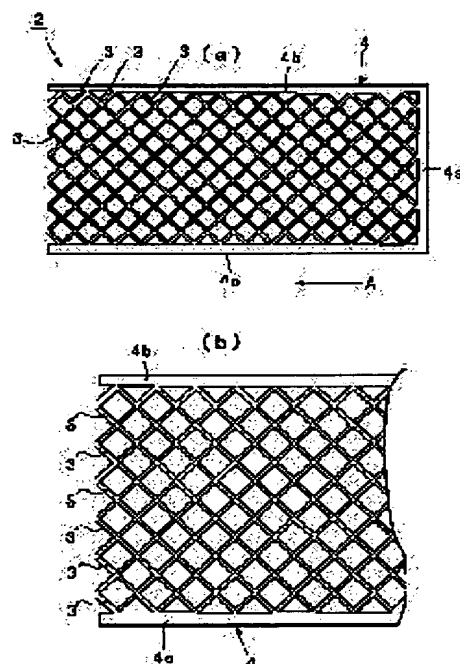
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OKUYAMA SHINGO**(54) MANUFACTURING METHOD OF LAMINATED CERAMIC ELECTRONIC COMPONENT AND ELECTRODE-PRINTING APPARATUS****(57)Abstract:**

PROBLEM TO BE SOLVED: To provide a manufacturing method that can print a plurality of electrode patterns onto a ceramic green sheet by a photogravure printing roll accurately, and to improve laminated ceramic electronic components.

SOLUTION: In the manufacturing method of laminated ceramic electronic components, a process for printing a plurality of electrode patterns onto a ceramic green sheet by a photogravure printing roll is provided. The photogravure printing roll has a plurality of printing sections corresponding to the plurality of electrode patterns on an outer surface. A printing section 2 has a plurality of recesses 3 that are arranged in the printing section 2, a first portion 4a that is extended in a direction nearly orthogonally crossing a printing direction at the printing direction front end of the plurality of recesses 3, and second portions 4b and 4c that extend from both the ends of the first portion 4a backward for surrounding the plurality of recesses 3. The printing direction back end of the printing section 2 is in a shape other than a straight line that is extended in a direction that orthogonally crosses the printing direction, thus suppressing printing fail at the printing direction back end on a ceramic green sheet.

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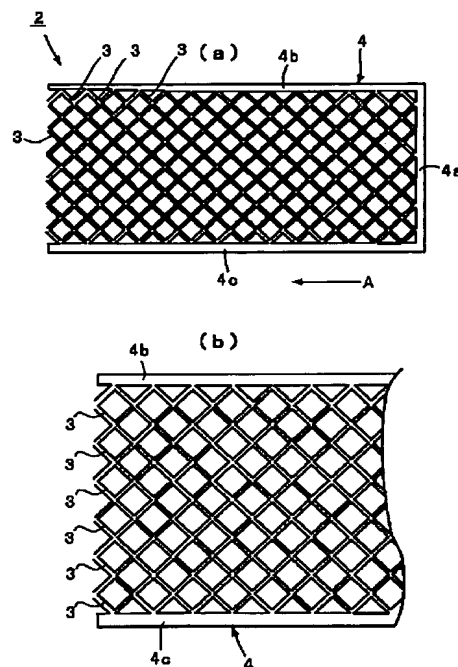
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(54) 【発明の名称】 積層セラミック電子部品の製造方法及び電極印刷装置

(57) 【要約】

【課題】 グラビア印刷ロールを用いて複数の電極パターンをセラミックグリーンシート上に高精度に印刷することができ、積層セラミック電子部品を高めることができる製造方法を提供する。

【解決手段】 セラミックグリーンシート上に複数の電極パターンをグラビア印刷ロールを用いて印刷する工程を備え、該グラビア印刷ロールが、複数の電極パターンに応じた複数の印刷部を外表面に有しており、印刷部2が、印刷部2内に配置された複数の凹部3と、複数の凹部3の印刷方向前端において印刷方向と略直交する方向に延びる第1の部分4aと、第1の部分4aの両端から後方に向かってかつ複数の凹部3を囲むように延びる第2の部分4b、4cとを備え、印刷部2の印刷方向後端が印刷方向と直交する方向に延びる直線以外の形状とされているため、セラミックグリーンシート上において印刷方向後端の印刷不良が抑制される、積層セラミック電子部品の製造方法。



【請求項 3】 前記支持フィルム上において、前記セラミックグリーンシートと電極とを有する積層シートを複数回形成して、複数層の積層体を構成し、この複数層の積層体を積層してマザーの積層体を得る、請求項 2 に記

【0003】特開平3-108307号公報には、導電ペーストをセラミックグリーンシートに印刷するグラビア印刷方法が開示されている。すなわち、図16に示すように、この先行技術に記載の方法では、供給ロール101からセラミックグリーンシート102が繰り出されている。セラミックグリーンシート102は、ロール103を介して、剛体ロール104とバックアップロール

105との間に導かれる。剛体ロール104の外表面には、図17に略図的断面図で示すように、導電ペーストの印刷パターンの形状に応じた複数の凹部104aが形成されている。

【0004】図16に示されているように、剛体ロール104は、下方部分が導電ペースト106に浸漬されており、剛体ロール104は、図示の矢印で示すように回転される。剛体ロール104の回転により、剛体ロール104の外面に付着した導電ペースト106が剛体ロール104とバックアップロール105との対向している部分に運ばれる。

【0005】また、ブレード107により、剛体ロール104の外表面に付着している余剰の導電ペーストが掻き取られる。そのため、剛体ロール104とバックアップロール105とが対向している部分においてセラミックグリーンシート102の一方面に凹部104aに充填されていた導電ペーストが印刷される。このようにして、凹部104aの形状に応じた電極パターンがセラミックグリーンシート102に印刷される。

【0006】なお、セラミックグリーンシート102に電極パターンが印刷された後、ヒーター108において乾燥され、巻き取られる。実際の積層セラミック電子部品の製造に際しては、マザーのセラミックグリーンシート上に、上記のような方法にしたがって、複数の電極パターンが印刷されている。

【0007】

【発明が解決しようとする課題】しかしながら、上述した従来のグラビア印刷法により導電ペーストを印刷した場合、印刷された電極パターンにおいて、印刷方向後端に印刷方向後方に延びる導電ペーストの引きずりが生じることがあった。

【0008】図18は、セラミックグリーンシート102上に複数の矩形の電極パターン111を上記先行技術に記載の方法にしたがって印刷した状態を示す略図的部分切欠平面図である。図18において、印刷は右側から左側に向かって行われる。図18から明らかなように、矩形の電極パターン111の印刷方向後端において、矢印Aで示す導電ペーストの引きずりが生じていることがわかる。これは、図17に示されているように、ブレード107により余剰の導電ペーストを掻き取る際に、ブレード107の先端が凹部104aの印刷方向後端部分においてパウンドし、そのため凹部104aの印刷方向後端近傍において剛体ロール部104の外表面から余分な導電ペーストを確実に掻き取るができずに残存し、これが印刷されてしまうことによると考えられる。

【0009】従って、上述した先行技術に記載の方法では、図18に示したような印刷不良が生じることがあり、得られた積層セラミック電子部品において、静電容量などの電気的特性がばらついたり、短絡不良または絶縁抵抗不良などが生じたりする恐れがあった。

【0010】本発明の目的は、上述した従来技術の欠点を解消し、電極パターンの印刷方向後端において導電ペーストの引きずりを生じることなく、電極パターンを高精度に印刷し得る工程を備えた積層セラミック電子部品の製造方法を提供することにある。

【0011】本発明の他の目的は、グラビア印刷ロールを用いてペーストを被印刷体の表面に印刷するためのグラビア印刷装置であって、印刷方向後端における印刷不良を生じさせることなく、高精度にペーストを印刷することを可能とするグラビア印刷装置を提供することにある。

【0012】

【課題を解決するための手段】第1の発明に係る積層セラミック電子部品の製造方法は、セラミックグリーンシートを用意する工程と、前記セラミックグリーンシート上に、グラビア印刷ロールを用いて複数の電極パターンを印刷する工程とを備え、前記グラビア印刷ロールが、複数の電極パターンに応じた複数の印刷部を外表面に有し、各印刷部が、該印刷部内に配置された複数の凹部と、複数の凹部を取り囲んでおり、かつ複数の凹部が集合されている部分の印刷方向前端において印刷方向と略直交する第1の部分及び該第1の部分の両端から印刷方向後端に向かって延びる第2の部分の部分を有する枠状凹部とを備え、かつ印刷部の印刷方向後端が、印刷方向と直交する直線以外の形状とされており、複数の電極パターンが印刷された複数枚のセラミックグリーンシートを少なくとも積層し、マザーの積層体を得る工程と、前記マザーの積層体を個々の積層セラミック電子部品単位の積層体に切断する工程と、個々の積層セラミック電子部品単位の積層体を焼成して焼結体を得る工程と、前記焼結体の外表面に外部電極を形成する工程とを備える。

【0013】第2の発明に係る積層セラミック電子部品の製造方法は、支持フィルム上に、グラビア印刷ロールを用いて複数の電極パターンを印刷する工程を備え、前記グラビア印刷ロールが、複数の電極パターンに応じた複数の印刷部を外表面に有し、各印刷部が、該印刷部内に配置された複数の凹部と、複数の凹部を取り囲んでおり、かつ複数の凹部が集合されている部分の印刷方向前端において印刷方向と略直交する第1の部分及び該第1の部分の両端から印刷方向後端に向かって延びる第2の部分の部分を有する枠状凹部とを備え、かつ印刷部の印刷方向後端が、印刷方向と直交する直線以外の形状とされており、前記支持フィルム上に複数の電極パターンを印刷した後に、該支持フィルム上にセラミックグリーンシートとの積層シートを得る工程と、前記積層シートを複数枚積層し、マザーの積層体を得る工程と、前記マザーの積層体を個々の積層セラミック電子部品単位の積層体に切断する工程と、前記積層体を焼成して、焼結体を得る工程と、前記焼結体の外表面に外部電極を形成する工程

とを備える。

【0014】第2の発明の他の特定の局面では、支持フィルム上において、セラミックグリーンシートと電極とを有する積層シートが複数回形成されて複数層の積層体が構成され、この複数層の積層体が積層されて、マザーの積層体が得られる。なお、この場合、積層シートだけでなく、積層シートの上下に無地のセラミックグリーンシートが積層されてもよい。

【0015】第2の発明に係る積層セラミック電子部品の製造方法のさらに別の特定の局面では、上記支持フィルムに支持された積層シートが転写法により積層され、それによってマザーの積層体が得られる。

【0016】第1、第2の発明の特定の局面では、印刷された複数の電極パターン間に該電極パターンと同等の厚みの誘電体層を形成する工程がさらに備えられる。

【0017】第1、第2の発明に係る積層セラミック電子部品の製造方法の別の特定の局面では、前記印刷部の後端に、印刷方向と交差する方向に枠状凹部が形成されておらず、印刷部の後端が、印刷方向と平行に伸びる枠状凹部の第2の部分の後端と前記複数の凹部の後端とにより構成されている。

【0018】第1、第2の発明に係る積層セラミック電子部品の製造方法のさらに他の特定の局面では、前記枠状凹部が、前記第2の部分の後端間を結ぶ方向であって、かつ印刷方向と直交する方向に対して交差する方向に伸びる第3の部分の有する。

【0019】本願の第3の発明は、被印刷体の表面にペーストにより複数の印刷図形を印刷するためのグラビア印刷装置であって、外表面に複数の印刷図形に応じた複数の印刷部が形成されており、各印刷部が、印刷方向後端において、印刷方向と直交する方向に伸びる直線以外の形状を有するように構成されているグラビア印刷ロールと、前記グラビア印刷ロールの外表面に当接され、余分なペーストを除去するブレードとを備える。

【0020】

【発明の実施の形態】以下、図面を参照しつつ本発明の具体的な実施例を説明することにより、本発明を明らかにする。

【0021】本発明の第1の実施例の積層セラミック電子部品の製造方法を図1～図8を参照して説明する。まず、マザーのセラミックグリーンシートを用意する。次に、マザーのセラミックグリーンシート上にグラビア印刷ロールを用いて内部電極を形成するための複数の電極パターンを印刷する。図4は、グラビア印刷ロールの外観を示す斜視図である。グラビア印刷ロール1はステンレスなどの剛性材料からなり、円筒状の外表面を有する。グラビア印刷ロール1の外表面には、矩形の内部電極に応じた印刷部2が複数形成されている。図4から明らかなように、複数の印刷部2は、グラビア印刷ロール1の外表面において、周方向に直交する方向において複

数形成されており、かつ周方向においても、複数の印刷部2が所定の間隔を隔てて形成されている。

【0022】印刷部2は、導電ペーストを保持し、該印刷部2の矩形の形状に応じた電極パターンをセラミックグリーンシート上に印刷するために設けられている。各印刷部2は、実際には、複数の凹部と、複数の凹部を囲むように設けられた枠状凹部とを有する。図1(a)、

(b)は、印刷部2の詳細を示す模式的拡大平面図及び部分切欠拡大平面図である。

【0023】図1(a)に示すように、一つの印刷部2は、該印刷部内に配置された複数の凹部3と、枠状凹部4とを有する。複数の凹部3は、矩形の印刷部のほぼ全領域を占めるように、マトリックス状に配置されている。本実施形態では、凹部3は菱形の平面形状を有するが、凹部3の平面形状では円、三角形、矩形などの適宜の形状とされ得る。

【0024】図1(a)において、矢印Aは印刷方向を示す。すなわち、矢印Aの基端側から基端に向かって印刷が行われる。枠状凹部4は、印刷方向前端に設けられた第1の部分4aと、第1の部分の両端に連ねられており、かつ印刷方向と平行に、かつ印刷部2の後端に向かって伸びる一対の第2の部分4b、4cとを有する。第1の部分4aは、印刷方向前端において、印刷方向と直交する方向に直線状に伸びており、第2の部分4b、4cは、全端側において第1の部分4aに連ねられており、他端側印刷部2の後端に至るように形成されている。

【0025】従って、印刷部2の印刷方向後端は、図1(b)に拡大して示すように、印刷方向後端側に配置されている複数の凹部3と上記枠状凹部4の第2の部分4b、4cの後端とにより構成されている。いいかえれば、印刷部2の印刷方向後端は、印刷方向と直交する方向に伸びる直線以外の形状を有するように構成されている。

【0026】図3は、上記グラビア印刷ロール1の印刷部2に導電ペースト5を付与する工程を示す略図的表面断面図である。図3に示すように、印刷に際しては、グラビア印刷ロール1は導電ペースト5内に下方部分が浸漬され、図示の矢印方向に回転される。

【0027】グラビア印刷ロール1の外表面に導電ペースト5が付着し、しかる後、余分の導電ペースト、すなわち印刷部2の凹部3及び枠状凹部4以外の外表面部分に付着した導電ペーストがドクターブレード6により掻き取られる。

【0028】この場合、各印刷部2の後端が上記のように印刷方向と直交する方向に伸びる直線以外の形状とされているので、ドクターブレード6が各印刷部2の印刷方向後端においてバウンドし難い。そのため、印刷部2の後方において余分な導電ペーストが付着し難いため、印刷部2の凹部3及び枠状凹部4に付与された導電ペー

ストがセラミックグリーンシートに転写され、図 2 に示されている矩形形状の電極パターン 7 を確実に形成することができる。

【0029】本実施例の特徴は、このように、グラビア印刷ロール 1 の各印刷部 2 の印刷方向後端が、印刷方向と直交する方向に延びる直線以外の形状とされていることにより、それによって電極パターン 7 を高精度に印刷することを可能としたことにある。

【0030】図 5 は、上記のようにして複数の電極パターンが印刷されたセラミックグリーンシートを示す。なお、図 5 においては、支持フィルム 11 上にマザーのセラミックグリーンシート 12 が支持されており、この支持フィルム 11 に支持されたセラミックグリーンシート 12 に、上記グラビア印刷ロール 1 を用いて複数の電極パターン 7 がマトリクス状に印刷されている。

【0031】本実施例の製造方法では、上記のようにしてセラミックグリーンシート 12 の一面に複数の電極パターン 7 が印刷された複数枚の積層シート 13 が、支持フィルム 11 から剥離されて転写法により積層される。しかる後、上下に無地のセラミックグリーンシートが積

層され、図 6 に示すマザーの積層体 17 が得られる。

【0032】次に、マザーの積層体 17 を厚み方向に切断し、図 7 に拡大して示す積層コンデンサ単位の積層体 18 を得る。しかる後、積層体 18 を焼成することにより、図 8 に示す焼結体 19 が得られる。焼結体 19 内においては、上記電極パターン 7 の切断により得られた内部電極 20a～20d がセラミック層を介して重なり合うように配置されている。また、セラミック焼結体 19 の端面 19a、19b に外部電極 21、22 を形成することにより、積層コンデンサ 23 が得られる。

【0033】得られた積層コンデンサ 23 では、内部電極 20a～20d を形成するための上述した電極パターン 7 がマザーのセラミックグリーンシート 12 上において高精度印刷されているので、内部電極形状の精度が高められる。従って、静電容量のばらつきを低減することができ、短絡不良や絶縁抵抗不良を抑制することができる。

【0034】第 1 の実施例では、図 5 に示した積層シート 13 が、転写法により積層され、マザーの積層体 17 が得られていたが、マザーの積層体 17 を得る工程はこれに限定されるものではない。

【0035】すなわち、図 9 に示すように、支持フィルム 11 上において、セラミックグリーンシート 12 及び電極パターン 7 を有する積層シート 13 を形成した後、該積層シート 13 の上にさらにセラミックグリーンシート 24 及び電極パターン 7A を同様に形成する工程を繰り返すことにより、支持フィルム 11 上において複数層の積層体を形成して、この複数層の積層体を積層して、マザーの積層体 17 を形成してもよい。この場合、セラミックグリーンシートに変えて、セラミックペーストを

塗布し、硬化させることによりセラミック層を形成してもよい。

【0036】図 10 は、第 2 の実施例に係る積層セラミック電子部品の製造方法を説明するための断面図である。第 1 の実施例では、セラミックグリーンシート上に複数の電極パターン 7 が形成されていたが、第 2 の実施例では、図 10 に示すように、まずポリエチレンテレフタレートフィルムのような合成樹脂フィルムからなる支持フィルム 31 上において、第 1 の実施例で用いられたグラビア印刷ロール 1 を用いて複数の電極パターン 7C が印刷される。この場合においても、グラビア印刷ロール 1 が前述したように構成されているので、支持フィルム 31 上に高精度に電極パターン 7C が形成され得る。しかる後、支持フィルム 31 上に電極パターン 7C が形成されている領域を被覆するようにセラミックグリーンシート 32 を形成する。このようにして、セラミックグリーンシート 32 の下面に複数の電極パターン 7C が形成された積層シート 33 を得ることができる。この積層シート 33 を第 1 の実施例と同様に転写法により積層することにより、マザーの積層体を得られてもよい。

【0037】あるいは、図 11 に示すように、支持フィルム 31 上において、上記積層シート 33 を形成した後、さらに、積層シートを形成する工程を繰り返し、電極パターン 7D 及びセラミックグリーンシート 34 を形成し、それによってマザーの積層体を得てもよい。

【0038】図 12 は、第 2 の実施例の変形例を説明するための正面断面図である。第 2 の実施例では、支持フィルム 31 上に、複数の電極パターン 7C が形成された後、セラミックグリーンシート 32 が形成されていたが、図 12 に示すように、複数の電極パターン 7C を形成した後、複数の電極パターン 7C 間にセラミックペーストを電極パターン 7C と同等の厚みとなるように印刷し、複合シート 41 を形成してもよい。この複合シート 41 では、セラミックペースト 42 が電極パターン 7C 間に配置されているため、複合シート 41 の上面が平坦とされている。

【0039】従って、複合シート 41 上に、セラミックグリーンシート 43 を積層し、さらに、複合シート 41 及びセラミックグリーンシートを積層する工程を繰り返すことによりマザーの積層体を得た場合、電極パターン 7C が重なり合っている部分と他の部分との厚みの差を低減することができる。すなわち、マザーの積層体を焼成に先立ち厚み方向に加圧した場合、電極パターン 7C が重なり合っている部分と、電極パターン 7C が設けられていない部分との密度差を低減することができ、デラミネーションの発生を抑制することができる。

【0040】なお、図 12 に示した変形例のように、支持フィルム上に電極パターン 7C を形成した後に、電極パターン 7 間に電極パターン 7C と同等の厚みにセラミックペーストを印刷する方法は従来より知られていた。

しかしながら、従来法において、電極パターン 7C をグラビア印刷法で形成した場合には、印刷方向後端において前述した引きずりが生じるため、図 13 に示すようにセラミックペースト 121 を印刷した場合、セラミックペースト 121 の端部が電極パターン 122 の印刷方向後端における引きずり部 122a 上に盛り上がって塗布されることになる。すなわち、従来法を用いた場合、電極パターン間に電極パターンと同等の厚みにセラミックペーストを高精度に印刷することが困難であったのに対し、本発明を利用すれば、このような電極パターンの印刷方向後端に引きずり部が生じないので、高精度にセラミックペーストを電極パターンと同等の厚みに印刷し、平坦な積層シート 43 を容易に得ることができる。

【0041】また、第 1 の実施例においても、セラミックグリーンシート上に複数の電極パターン 7 を形成した後、複数の電極パターン 7 間を埋めるように複数の電極パターン 7 と同等の厚みにセラミックペーストを印刷してセラミックグリーンシート層を形成してもよく、図 12 に示した変形例と同様に、それによって緻密な焼結体を得ることができる。

【0042】前述してきた実施例及び変形例では、図 1 に (a) に示した形状の印刷部 2 が設けられていたが、本発明において、グラビア印刷ロールの印刷部の形状は適宜変形され得る。図 14 (a) ~ (c) 及び図 15 は、印刷部の変形例を示す各模式的平面図である。

【0043】図 14 (a) ~ (c) 及び図 15 においては、印刷方向は図面の右側から左側であり、従って、図面の右側が印刷方向前端となる。図 14 (a) に示した印刷部 51 では、複数の凹部 52 が設けられている部分の外側に枠状凹部 53 が設けられている。印刷部 51 では、枠状凹部 53 は、印刷部 2 と同様に、印刷方向前端において印刷方向と直交する方向に延びる第 1 の部分 53a と、第 1 の部分 53a の両端から印刷方向後端に延びる第 2 の部分 53b、53c とを有する。さらに、印刷部 51 では、第 3 の部分 53d が設けられている。第 3 の部分 53d は、一対の枠状凹部 52b、52c を印刷方向後端で結ぶように形成されているが、図 14

(a) から明らかなように、印刷方向と交差する方向において直線状に延ばされている。複数の凹部 52 は、このような閉環状の枠状凹部 53 により取り囲まれている。

【0044】印刷部 51 においては、その印刷方向後端部分は上記枠状凹部 53 の第 3 の部分 53d により構成されているため、印刷部 51 の後端は印刷方向と直交する直線以外の形状とされている。従って、印刷に際し、ドクターブレードが印刷方向後端においてバウンドし難く、所望通りの形状に導電ペーストを印刷することができる。

【0045】図 14 (b) に示す印刷部 54 では、上記枠状凹部 53 の第 3 の部分 53e が、略 V 字状の形状を

有しており、したがって、印刷部 51 と同様に、印刷部 54 の後端は、印刷方向と直交する直線以外の形状とされているため、印刷部 51 と同様に印刷に際してのドクターブレードの印刷方向後端におけるバウンドを抑制することができる。

【0046】図 14 (c) に示す印刷部 55 では、枠状凹部 53 の第 3 の部分 53f が後方に突出した半円状の形状を有する。また、図 15 に示す印刷部 56 では、印刷方向後端における枠状凹部 53 の第 3 の部分 53g が印刷方向前方に向かって突出した半円状の形状を有する。このように、印刷部において、枠状凹部の印刷方向後端に位置している第 3 の部分の形状は、印刷方向と直交する方向に延びる直線以外の形状であれば特に限定されず、様々な形状とすることができる。

【0047】なお、上述してきた実施例及び変形例では、積層セラミック電子部品の製造に際し、上述したグラビア印刷ロール 1 を用いて導電ペーストがセラミックグリーンシートや支持フィルムに印刷されていたが、上記グラビア印刷ロール 1 は、導電ペーストの印刷に限らず、ガラスペーストや接着剤ペーストなどの様々なペーストの印刷に適用することができ、被印刷体についても、セラミックグリーンシートや支持フィルムに限らず、様々な材料及び形状からなる被印刷体を用いることができる。

【0048】さらに、本発明に係る積層セラミック電子部品の製造方法は、上述した積層コンデンサに限らず、多層基板、LC フィルタ、積層インダクタなどの様々な積層セラミック電子部品の製造に広く用いられ得る。

【0049】

【発明の効果】第 1 の発明に係る積層セラミック電子部品の製造方法では、グラビア印刷ロールを用いてセラミックグリーンシート上に複数の電極パターンを印刷するにあたり、グラビア印刷ロールの各印刷部において、印刷方向後端が印刷方向と直交する方向に延びる直線以外の形状とされているため、印刷された電極パターンにおける印刷方向後端の引きずりなどの印刷不良が生じ難い。

【0050】従って、セラミックグリーンシート上に高精度に印刷部に応じた電極パターンを印刷することができ、静電容量などの電気的特性のばらつきなどが少なく、短絡不良や絶縁抵抗不良などが生じ難い積層セラミック電子部品を提供することができる。

【0051】第 2 の発明に係る製造方法では、支持フィルム上に複数の電極パターンをグラビア印刷ロールを用いて印刷するにあたり、グラビアロール外面の各印刷部の印刷方向後端が、印刷方向と直交する直線以外の形状とされているので、第 1 の発明の場合と同様に、支持フィルム上に電極パターンを高精度に印刷することができ、印刷不良が生じ難いため、静電容量などの電気的特性のばらつきが少なく、短絡不良や絶縁抵抗不良などが

生じ難い積層セラミック電子部品を提供することができる。

【0052】支持フィルム上において、セラミックグリーンシートと電極とを有する積層シートを複数回形成し、マザーの積層体を得る場合には、マザーの積層体を得る積層工程を支持フィルム上で行うことができ、積層に際しての作業スペースを低減することができる。

【0053】また、支持フィルムに支持された積層シートを転写法により積層し、マザーの積層体を得る場合には、厚みの薄いセラミックグリーンシートを形成した場合であっても、支持フィルムに支持された状態で積層を安定に行うことができる。

【0054】印刷された複数の電極パターン間に、該電極パターンと同等の厚みのセラミックグリーンシート層を形成する工程をさらに備える場合には、マザーの積層体を厚み方向に加圧した際に、電極パターンが重なり合っている部分と電極パターンが存在しない部分との段差が生じ難く、したがって緻密な焼結体を得ることができ、デラミネーションなどの発生を抑制することができる。

【0055】印刷部の印刷方向後端に、印刷方向と交差する方向に枠状凹部が形成されておらず、印刷部の後端が、印刷方向と平行に延びる枠状凹部の第2の部分の後端と複数の凹部の後端とにより構成されている場合には、該第2の部分の後端と複数の凹部の後端とが、印刷方向と直交する方向に延びる直線とはならないため、本発明にしたがって、印刷方向後端における印刷不良を抑制することができる。

【0056】枠状凹部が第2の部分の後端において、印刷方向と直交する方向に対して交差する方向に延びる第3の部分の部分を有する場合には、この第3の部分において余分な導電ペーストを掻き取るためのブレードのバウンドが生じ難いため、本発明にしたがって印刷方向後端における印刷不良を抑制することができる。

【0057】本発明に係るグラビア印刷装置は、印刷方向後端において印刷方向と直交する方向に延びる直線以外の形状を有する印刷部が外表面に形成されたグラビア印刷ロールと、余分なペーストを除去するブレードとを備えるため、ブレードにより余分なペーストを除去する際に、印刷方向後端においてブレードのバウンドが生じ難い。従って、ペーストを印刷部の形状にしたがって高精度の印刷することができる。

【図面の簡単な説明】

【図1】(a)、(b)は、本発明に係る積層セラミック電子部品の製造方法に用いられるグラビア印刷ロールの外表面に形成されている印刷部の形状を説明するための模式的平面図及びその一部を拡大して示す模式的平面図。

【図2】図1(a)で示した印刷部により印刷された電

極パターンの形状を示す模式的平面図。

【図3】本発明の第1の実施例において、グラビア印刷ロールの印刷部に導電ペーストを保持すると共に、ブレードにより余分な導電ペーストを除去する工程を示す模式的正面断面図。

【図4】本発明の第1の実施例で用いられるグラビア印刷ロールの外観を示す斜視図。

【図5】本発明の第1の実施例において支持フィルム上においてセラミックグリーンシートを形成し、該セラミックグリーンシート上に複数の電極パターンを形成した状態を示す正面断面図。

【図6】本発明の第1の実施例で得られるマザーの積層体を説明するための正面断面図。

【図7】個々の積層コンデンサ単位の積層体を示す正面断面図。

【図8】本発明の第1の実施例により得られる積層コンデンサを示す正面断面図。

【図9】第1の実施例の変形例において、支持フィルム上において複数のセラミックグリーンシート及び複数の電極パターンを積層してマザーの積層体を得た状態を示す正面断面図。

【図10】本発明の第2の実施例において支持フィルム上に複数の電極パターンを印刷した後、セラミックグリーンシート層を形成した状態を示す正面断面図。

【図11】本発明の第2の実施例の変形例において、電極パターン及びセラミックグリーンシートの積層工程を複数回繰り返した状態を示す模式的正面断面図。

【図12】本発明の他の変形例を説明するための図であり、複数の電極パターン間にセラミックグリーンシート層を形成する方法を説明するための正面断面図。

【図13】従来技法において電極パターン間にセラミックグリーンシートを形成した場合の問題点を説明するための部分切欠拡大正面断面図。

【図14】(a)～(c)は、本発明に係るグラビア印刷装置のグラビア印刷ロール外表面に形成される印刷部の形状の変形例を示す各模式的平面図。

【図15】本発明において用いられるグラビア印刷ロールの外表面に形成された印刷部の形状の他の例を説明するための模式的平面図。

【図16】従来の積層セラミック電子部品の製造に際してセラミックグリーンシート上に電極パターンをグラビア印刷する工程を説明するための概略構成図。

【図17】従来法において、グラビア印刷ロール上の余分な導電ペーストをブレードにより除去する工程を説明するための部分切欠断面図。

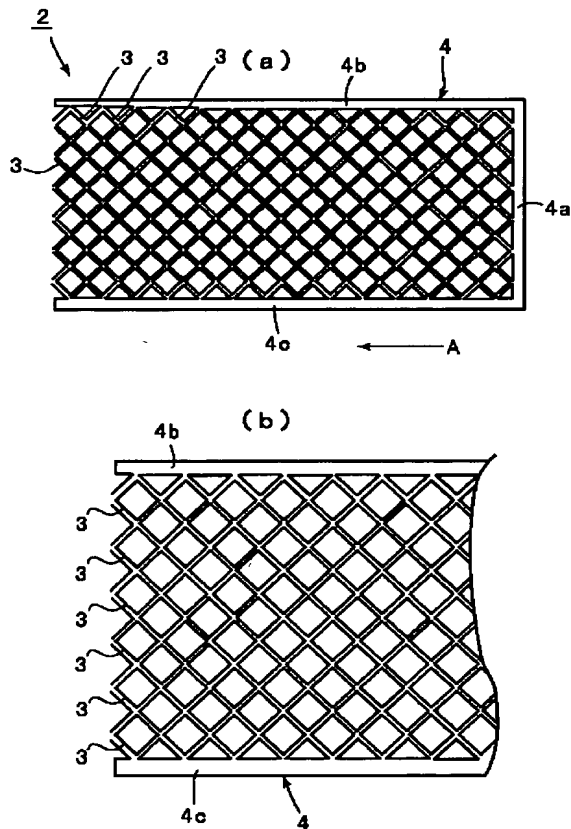
【図18】従来法にしたがって、セラミックグリーンシート上に複数の電極パターンが印刷された場合の問題点を説明するための部分切欠平面図。

【符号の説明】

1…グラビア印刷ロール

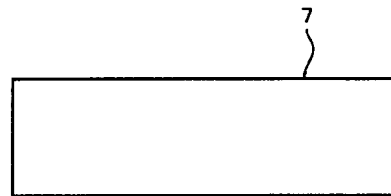
- 2…印刷部
 3…凹部
 4…枠状凹部
 4a…第1の部分
 4b, 4c…第2の部分
 4d…第3の部分
 5…導電ペースト
 6…ブレード
 7…電極パターン
 7A, 7C, 7D…電極パターン
 11…支持フィルム
 12…セラミックグリーンシート
 13…積層シート
 17…マザーの積層体
 18…積層体

【図1】

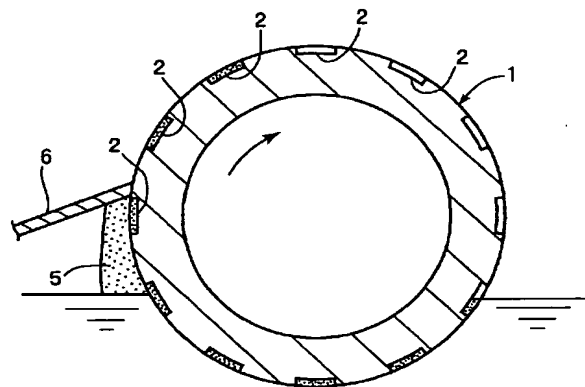


- 19…焼結体
 20a~20d…内部電極
 21, 22…外部電極
 23…積層コンデンサ
 31…支持フィルム
 32…セラミックグリーンシート
 33…積層シート
 42…セラミックペースト
 51, 54, 55, 56…印刷部
 52…凹部
 53…枠状凹部
 53a…第1の部分
 53b, 53c…第2の部分
 53d~53g…第3の部分

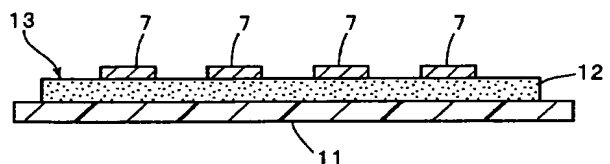
【図2】



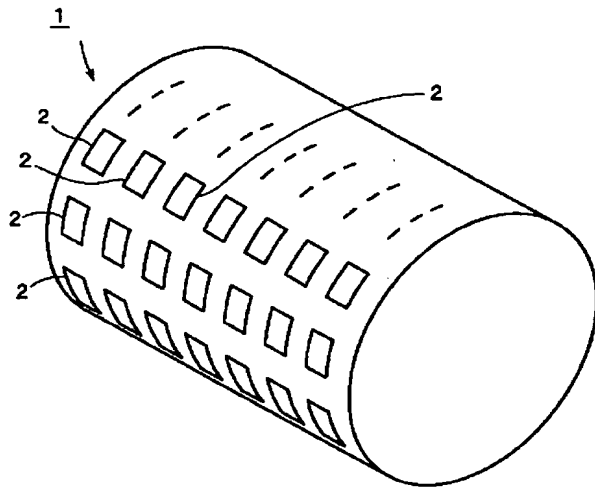
【図3】



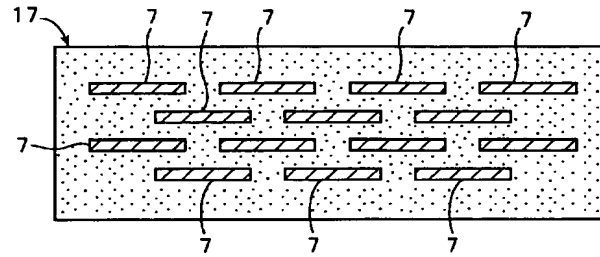
【図5】



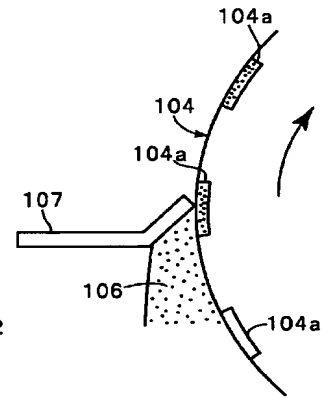
【図 4】



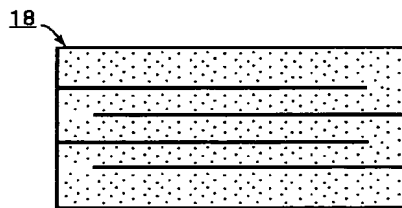
【図 6】



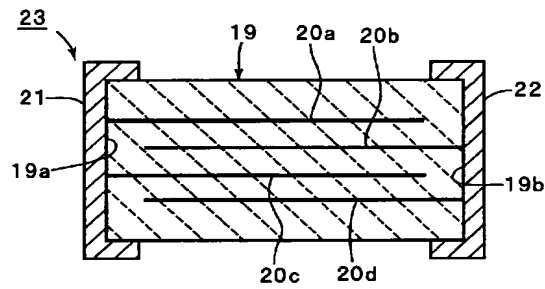
【図 17】



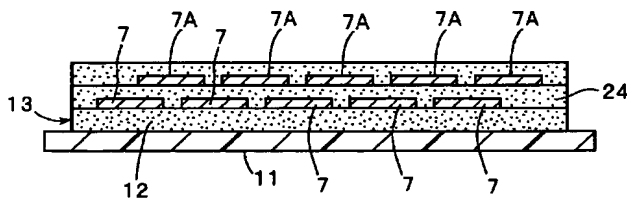
【図 7】



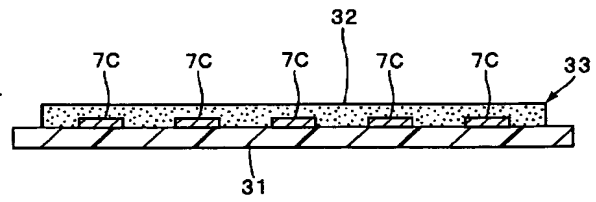
【図 8】



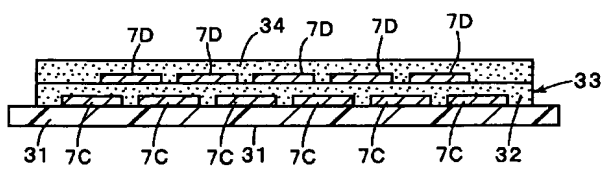
【図 9】



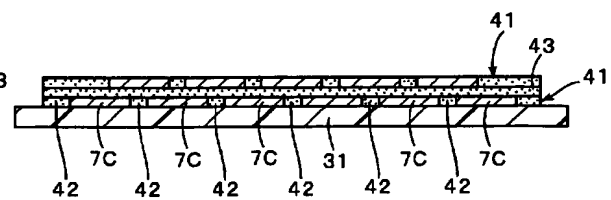
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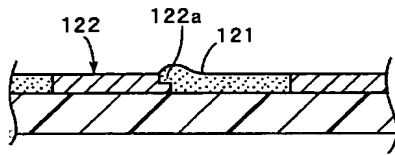
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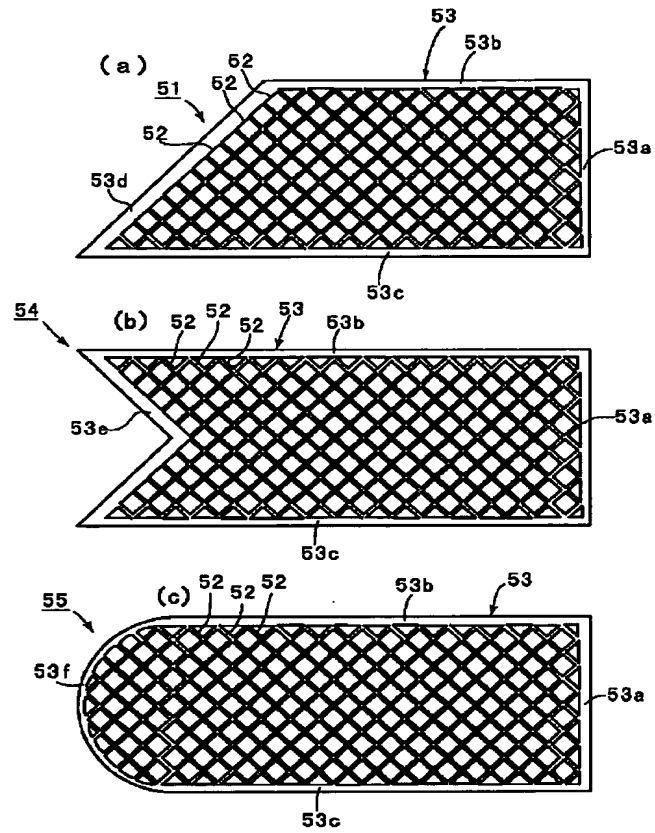
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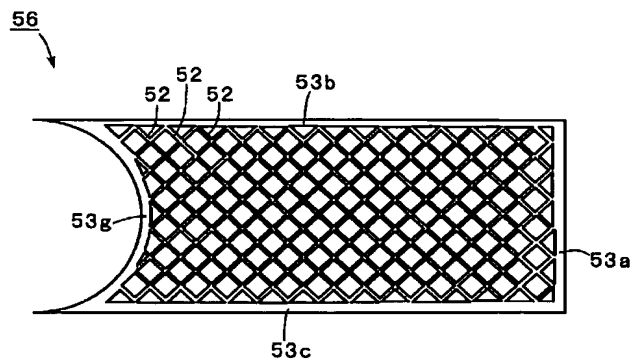
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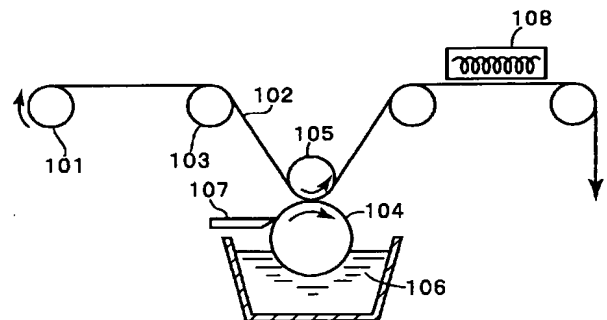
【図 14】



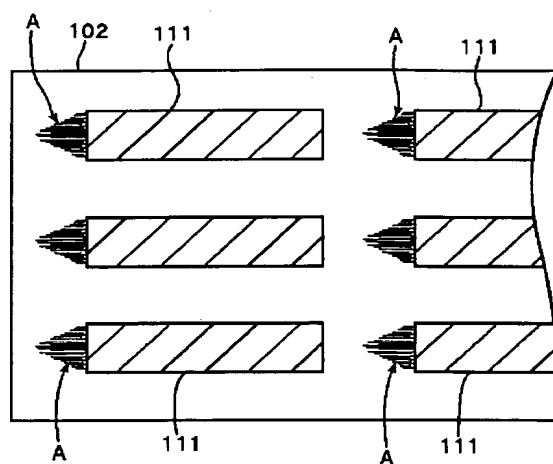
【図 15】



【図 16】



【図 18】



PATENT ABSTRACTS OF JAPAN

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(54) MANUFACTURING METHOD OF LAMINATED CERAMIC ELECTRONIC
COMPONENT AND ELECTRODE-PRINTING APPARATUS

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a manufacturing method that can print a plurality of electrode patterns onto a ceramic green sheet by a photogravure printing roll accurately, and to improve laminated ceramic electronic components.

SOLUTION: In the manufacturing method of laminated ceramic electronic components, a process for printing a plurality of electrode patterns onto a ceramic green sheet by a photogravure printing roll is provided. The photogravure printing roll has a plurality of printing sections corresponding to the plurality of electrode patterns on an outer surface. A printing section 2 has a plurality of recesses 3 that are arranged in the printing section 2, a first portion 4a that is extended in a direction nearly orthogonally crossing a printing direction at the printing direction front end of the plurality of recesses 3, and second portions 4b and 4c that extend from both the ends of the first portion 4a backward for surrounding the plurality of recesses 3. The printing direction back end of the printing section 2 is in a shape other than a straight line that is extended in a direction that orthogonally crosses the printing direction, thus suppressing printing fail at the printing direction back end on a ceramic green sheet.



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CLAIMS

[Claim(s)]

[Claim 1] The process which prepares a ceramic green sheet, and on said
ceramic green sheet Two or more crevices where it has the process which prints
two or more electrode patterns using a gravure roll, and has two or more printing
sections to which said gravure roll responded to two or more electrode patterns
in an outside surface, and each printing section has been arranged at these

printing circles, It has the frame-like crevice which has the 2nd part prolonged toward the printing direction back end from the both ends of the 1st part which carries out an abbreviation rectangular cross with the printing direction in the printing direction front end of the part into which two or more crevices are surrounded and two or more crevices have gathered, and this 1st part. And the printing direction back end of the printing section The process which is made into configurations other than the straight line which intersects perpendicularly with the printing direction, carries out the laminating of the ceramic green sheet of two or more sheets with which two or more electrode patterns were printed at least, and obtains a mother's layered product, The manufacture approach of laminating ceramic electronic parts equipped with the process which cuts said mother's layered product to the layered product of each laminating ceramic electronic-parts unit, the process which calcinates the layered product of each laminating ceramic electronic-parts unit, and obtains a sintered compact, and the process which forms an external electrode in the outside surface of said sintered compact.

[Claim 2] It has the process which uses a gravure roll and prints two or more electrode patterns on a support film. Two or more crevices where it has two or more printing sections to which said gravure roll responded to two or more electrode patterns in an outside surface, and each printing section has been arranged at these printing circles, It has the frame-like crevice which has the 2nd part prolonged toward the printing direction back end from the both ends of the 1st part which carries out an abbreviation rectangular cross with the printing direction in the printing direction front end of the part into which two or more crevices are surrounded and two or more crevices have gathered, and this 1st part. And the printing direction back end of the printing section After considering as configurations other than the straight line which intersects perpendicularly with the printing direction and printing two or more electrode patterns on said support film The process which forms a ceramic green sheet on this support film, and obtains the laminating sheet of said electrode pattern and ceramic green sheet, The process which carries out two or more sheet laminating of said laminating

sheet, and obtains a mother's layered product, and the process which cuts said mother's layered product to the layered product of each laminating ceramic electronic-parts unit, The manufacture approach of the laminating ceramic electronic parts which calcinate said layered product and are equipped with the process which obtains a sintered compact, and the process which forms an external electrode in the outside surface of said sintered compact.

[Claim 3] The manufacture approach of laminating ceramic electronic parts according to claim 2 of carrying out multiple-times formation of the laminating sheet which has said ceramic green sheet and electrode on said support film, constituting the layered product of two or more layers, carrying out the laminating of this layered product of two or more layers, and obtaining a mother's layered product.

[Claim 4] The manufacture approach of laminating ceramic electronic parts according to claim 2 of carrying out the laminating of the laminating sheet supported by said support film with a replica method, and obtaining a mother's layered product.

[Claim 5] The manufacture approach of the laminating ceramic electronic parts according to claim 1 to 4 further equipped with the process which forms the dielectric layer of thickness equivalent to this electrode pattern among two or more printed electrode patterns.

[Claim 6] The manufacture approach of the laminating ceramic electronic parts according to claim 1 to 5 which a frame-like crevice is not formed in the printing direction and the crossing direction in the back end of said printing section, but are constituted by the back end of the 2nd part of a frame-like crevice and the back end of two or more of said crevices to which the back end of the printing section extends in the printing direction and parallel.

[Claim 7] The manufacture approach of laminating ceramic electronic parts according to claim 1 to 5 that said frame-like crevice has connected between the back end of said 2nd part, and has the 3rd part prolonged in the printing direction and the direction which crosses to the direction where it intersects

perpendicularly.

[Claim 8] The gravure equipment have the blade which it is gravure equipment for printing two or more printing graphic forms with a paste on the front face of a printing hand-ed, two or more printing sections which embraced two or more printing graphic forms are formed in an outside surface, and it is contacted by the outside surface of the gravure roll constituted so that it may have configurations other than the straight line to which the printing direction back end of each printing section extends in the printing direction and the direction which intersects perpendicularly, and said gravure roll, and removes in an excessive paste.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the gravure equipment used for the manufacture approach of laminating ceramic electronic parts and this manufacture approach the process which prints the paste of conductive paste etc. on a ceramic green sheet or a resin film was improved by the detail more about the gravure equipment for printing the paste of conductive paste etc. in the

manufacture approach list of laminating ceramic electronic parts, such as a multilayer capacitor.

[0002]

[Description of the Prior Art] Conventionally, on the occasion of manufacture of laminating ceramic electronic parts, such as a multilayer capacitor, a multilayer substrate, or LC chip, in order to form an internal electrode, conductive paste was printed on the ceramic green sheet.

[0003] The gravure approach which prints conductive paste to a ceramic green sheet is indicated by JP,3-108307,A. That is, as shown in drawing 16, by the approach of a publication, the ceramic green sheet 102 has let out to this advanced technology from the supply roll 101. The ceramic green sheet 102 is led between the rigid-body roll 104 and the back up roll 105 through a roll 103. As shown to drawing 17 in a schematic-drawing-sectional view, two or more crevice 104a which embraced the configuration of the printing pattern of conductive paste is formed in the outside surface of the rigid-body roll 104.

[0004] It is immersed in conductive paste 106 in the lower part part, and as the arrow head of illustration shows, the rigid-body roll 104 rotates the rigid-body roll 104, as shown in drawing 16. The conductive paste 106 adhering to the external surface of the rigid-body roll 104 is carried to the part of the rigid-body roll 104 and the back up roll 105 which has countered by rotation of the rigid-body roll 104.

[0005] Moreover, the excessive conductive paste adhering to the outside surface of the rigid-body roll 104 is scratched by the blade 107. Therefore, on the other hand in the part which the rigid-body roll 104 and the back up roll 105 have countered, the conductive paste of the ceramic green sheet 102 with which crevice 104a was filled up is printed by the field. Thus, the electrode pattern according to the configuration of crevice 104a is printed by the ceramic green sheet 102.

[0006] In addition, after an electrode pattern is printed by the ceramic green sheet 102, it is dried and rolled round in a heater 108. On the occasion of

manufacture of actual laminating ceramic electronic parts, two or more electrode patterns are printed on a mother's ceramic green sheet according to the above approaches.

[0007]

[Problem(s) to be Solved by the Invention] However, when conductive paste was printed with the conventional gravure mentioned above, in the printed electrode pattern, the drag of the conductive paste prolonged in the printing direction back end in the printing direction back might arise.

[0008] Drawing 18 is the schematic-drawing-partial notching top view showing the condition of having printed the electrode pattern 111 of two or more rectangles according to the approach of a publication to the above-mentioned advanced technology on the ceramic green sheet 102. In drawing 18 , printing is performed toward left-hand side from right-hand side. In the printing direction back end of the rectangular electrode pattern 111, it turns out that the drag of the conductive paste shown by the arrow head A has arisen so that clearly from drawing 18 . In case this scratches excessive conductive paste with a blade 107 as shown in drawing 17 , it remains without the tip of a blade 107 bounding in the printing direction back end part of crevice 104a, therefore being able to scratch excessive conductive paste certainly from the outside surface of the rigid-body roll section 104 [near the printing direction back end of crevice 104a], and is considered to be because for this to be printed.

[0009] Therefore, by the approach given in the advanced technology mentioned above, in the laminating ceramic electronic parts which poor printing as shown in drawing 18 may arise, and were obtained, it was sufficient and there was a possibility which electrical characteristics, such as electrostatic capacity, produce in rose *****, a poor short circuit, or poor insulation resistance of carrying out.

[0010] The purpose of this invention is to offer the manufacture approach of laminating ceramic electronic parts equipped with the process which can print an electrode pattern with high precision, without canceling the fault of the conventional technique mentioned above and producing the drag of conductive

paste in the printing direction back end of an electrode pattern.

[0011] Other purposes of this invention are gravure equipment for printing a paste on the front face of a printing hand-ed using a gravure roll, and they are to offer the gravure equipment which makes it possible to print a paste with high precision, without producing poor printing in the printing direction back end.

[0012]

[Means for Solving the Problem] The manufacture approach of the laminating ceramic electronic parts concerning the 1st invention The process which prepares a ceramic green sheet, and on said ceramic green sheet Two or more crevices where it has the process which prints two or more electrode patterns using a gravure roll, and has two or more printing sections to which said gravure roll responded to two or more electrode patterns in an outside surface, and each printing section has been arranged at these printing circles, It has the frame-like crevice which has the 2nd part prolonged toward the printing direction back end from the both ends of the 1st part which carries out an abbreviation rectangular cross with the printing direction in the printing direction front end of the part into which two or more crevices are surrounded and two or more crevices have gathered, and this 1st part. And the printing direction back end of the printing section The process which is made into configurations other than the straight line which intersects perpendicularly with the printing direction, carries out the laminating of the ceramic green sheet of two or more sheets with which two or more electrode patterns were printed at least, and obtains a mother's layered product, It has the process which cuts said mother's layered product to the layered product of each laminating ceramic electronic-parts unit, the process which calcinates the layered product of each laminating ceramic electronic-parts unit, and obtains a sintered compact, and the process which forms an external electrode in the outside surface of said sintered compact.

[0013] The manufacture approach of the laminating ceramic electronic parts concerning the 2nd invention It has the process which uses a gravure roll and prints two or more electrode patterns on a support film. Two or more crevices

where it has two or more printing sections to which said gravure roll responded to two or more electrode patterns in an outside surface, and each printing section has been arranged at these printing circles, It has the frame-like crevice which has the 2nd part prolonged toward the printing direction back end from the both ends of the 1st part which carries out an abbreviation rectangular cross with the printing direction in the printing direction front end of the part into which two or more crevices are surrounded and two or more crevices have gathered, and this 1st part. And the printing direction back end of the printing section After considering as configurations other than the straight line which intersects perpendicularly with the printing direction and printing two or more electrode patterns on said support film The process which forms a ceramic green sheet on this support film, and obtains the laminating sheet of said electrode pattern and ceramic green sheet, Two or more sheet laminating of said laminating sheet is carried out, and it has the process which obtains a mother's layered product, the process which cuts said mother's layered product to the layered product of each laminating ceramic electronic-parts unit, the process which calcinates said layered product and obtains a sintered compact, and the process which forms an external electrode in the outside surface of said sintered compact.

[0014] On other specific aspects of affairs of the 2nd invention, multiple-times formation of the laminating sheet which has a ceramic green sheet and an electrode on a support film is carried out, the layered product of two or more layers is constituted, the laminating of this layered product of two or more layers is carried out, and a mother's layered product is obtained. In addition, the laminating of the plain ceramic green sheet may be carried out to the upper and lower sides of not only a laminating sheet but a laminating sheet in this case.

[0015] On still more nearly another specific aspect of affairs of the manufacture approach of the laminating ceramic electronic parts concerning the 2nd invention, the laminating of the laminating sheet supported by the above-mentioned support film is carried out by the replica method, and a mother's layered product is obtained by it.

[0016] On the specific aspect of affairs of the 1st and the 2nd invention, it has further the process which forms the dielectric layer of thickness equivalent to this electrode pattern among two or more printed electrode patterns.

[0017] A frame-like crevice is not formed in the printing direction and the crossing direction, but the back end of the printing section is constituted from an another specific aspect of affairs of the manufacture approach of the laminating ceramic electronic parts concerning the 1st and 2nd invention by the back end of said printing section by the printing direction, the back end of the 2nd part of the frame-like crevice which extends in parallel, and the back end of two or more of said crevices.

[0018] Further, on other specific aspects of affairs of the manufacture approach of the laminating ceramic electronic parts concerning the 1st and 2nd invention, said frame-like crevice is the direction to which between the back end of said 2nd part is connected, and it has the 3rd part prolonged in the direction which crosses to the printing direction and the direction which intersects perpendicularly.

[0019] Are gravure equipment for printing two or more printing graphic forms with a paste on the front face of a printing hand-ed, two or more printing sections which embraced two or more printing graphic forms are formed in the outside surface, and each printing section sets invention of the 3rd of this application to the printing direction back end. It is contacted by the outside surface of the gravure roll constituted so that it may have configurations other than the straight line prolonged in the printing direction and the direction which intersects perpendicularly, and said gravure roll, and has the blade which removes an excessive paste.

[0020]

[Embodiment of the Invention] Hereafter, this invention is clarified by explaining the concrete example of this invention, referring to a drawing.

[0021] The manufacture approach of the laminating ceramic electronic parts of the 1st example of this invention is explained with reference to drawing 1 - drawing 8 . First, a mother's ceramic green sheet is prepared. Next, two or more

electrode patterns for using a gravure roll and forming an internal electrode on a mother's ceramic green sheet, are printed. Drawing 4 is the perspective view showing the appearance of a gravure roll. The gravure roll 1 consists of rigid ingredients, such as stainless steel, and has a cylinder-like outside surface. Two or more formation of the printing section 2 according to a rectangular internal electrode is carried out at the outside surface of the gravure roll 1. In the outside surface of the gravure roll 1, two or more formation is carried out in the direction which intersects perpendicularly with a hoop direction, and also in the hoop direction, two or more printing sections 2 separate predetermined spacing, and two or more printing sections 2 are formed so that clearly from drawing 4 .

[0022] The printing section 2 holds conductive paste, and it is prepared in order to print the electrode pattern according to the configuration of the rectangle of this printing section 2 on a ceramic green sheet. Each printing section 2 has in fact two or more crevices and the frame-like crevice prepared so that two or more crevices might be surrounded. Drawing 1 (a) and (b) are the typical expansion top views and partial notching expansion top views showing the detail of the printing section 2.

[0023] As shown in drawing 1 (a), the one printing section 2 has two or more crevices 3 arranged at these printing circles, and the frame-like crevice 4. two or more crevices 3 -- the rectangular printing section -- it is arranged in the shape of a matrix so that all fields may be occupied mostly. In this operation gestalt, although a crevice 3 has the flat-surface configuration of a rhombus, it may be made into proper configurations, such as a circle, a triangle, and a rectangle, in the flat-surface configuration of a crevice 3.

[0024] In drawing 1 (a), an arrow head A shows the printing direction. That is, printing is performed toward a end face from the end face side of an arrow head A. The frame-like crevice 4 is put in a row by 1st partial 4a prepared in the printing direction front end, and the both ends of the 1st part, and has the 2nd part 4b and 4c of the pair prolonged toward the back end of the printing section 2 in parallel with the printing direction. 1st partial 4a is prolonged in the shape of a

straight line in the printing direction front end in the printing direction and the direction which intersects perpendicularly, and the 2nd part 4b and 4c is put in a row by 1st partial 4a in all one end, and it is formed so that it may result in the back end of the other end side printing section 2.

[0025] Therefore, the printing direction back end of the printing section 2 is constituted by the back end of the 2nd part 4b and 4c of two or more crevices 3 arranged at the printing direction back end side, and the above-mentioned frame-like crevice 4 so that it may expand to drawing 1 (b) and may be shown. In other words, the printing direction back end of the printing section 2 is constituted so that it may have configurations other than the straight line prolonged in the printing direction and the direction which intersects perpendicularly.

[0026] Drawing 3 is the schematic-drawing-surface sectional view showing the process which gives conductive paste 5 to the printing section 2 of the above-mentioned gravure roll 1. As shown in drawing 3, on the occasion of printing, a lower part part is dipped in conductive paste 5, and the gravure roll 1 rotates in the direction of an arrow head of illustration.

[0027] The conductive paste which conductive paste 5 adhered to the outside surface of the gravure roll 1, and adhered to outside-surface parts other than crevice [of excessive conductive paste 2, i.e., the printing section,] 3 and frame-like crevice 4 after an appropriate time is scratched by the doctor blade 6.

[0028] In this case, since it considers as configurations other than the straight line to which the back end of each printing section 2 extends as mentioned above in the printing direction and the direction which intersects perpendicularly, a doctor blade 6 cannot bound easily in the printing direction back end of each printing section 2. Therefore, since excessive conductive paste cannot adhere easily in the back of the printing section 2, the conductive paste given to the crevice 3 and the frame-like crevice 4 of the printing section 2 is imprinted by the ceramic green sheet, and can form certainly the electrode pattern 7 of the rectangle configuration shown in drawing 2.

[0029] The printing direction back end of each printing section 2 of the gravure

roll 1 has the description of this example in having made it possible to print the electrode pattern 7 with high precision by it in this way by considering as configurations other than the straight line prolonged in the printing direction and the direction which intersects perpendicularly.

[0030] Drawing 5 shows the ceramic green sheet with which two or more electrode patterns were printed as mentioned above. In addition, in drawing 5, the above-mentioned gravure roll 1 is used for the ceramic green sheet 12 which a mother's ceramic green sheet 12 is supported on the support film 11, and was supported by this support film 11, and two or more electrode patterns 7 are printed in the shape of a matrix.

[0031] By the manufacture approach of this example, the laminating sheet 13 of two or more sheets with which two or more electrode patterns 7 were printed by the whole surface of the ceramic green sheet 12 as mentioned above exfoliates from the support film 11, and a laminating is carried out with a replica method. After an appropriate time, the laminating of the plain ceramic green sheet is carried out up and down, and the layered product 17 of the mother who shows drawing 6 is obtained.

[0032] Next, a mother's layered product 17 is cut in the thickness direction, and the layered product 18 of the multilayer capacitor unit which expands to drawing 7 and is shown is obtained. The sintered compact 19 shown in drawing 8 is obtained by calcinating a layered product 18 after an appropriate time. It is arranged so that the internal electrodes 20a-20d obtained by cutting of the above-mentioned electrode pattern 7 may overlap through a ceramic layer in a sintered compact 19. Moreover, a multilayer capacitor 23 is obtained by forming the external electrodes 21 and 22 in the end faces 19a and 19b of the ceramic sintered compact 19.

[0033] In the obtained multilayer capacitor 23, since high precision printing of the electrode pattern 7 mentioned above for forming internal electrodes 20a-20d is carried out on a mother's ceramic green sheet 12, the precision of an internal electrode configuration is raised. Therefore, dispersion in electrostatic capacity

can be reduced and a poor short circuit and poor insulation resistance can be controlled.

[0034] Although the laminating of the laminating sheet 13 shown in drawing 5 was carried out by the replica method and a mother's layered product 17 was obtained in the 1st example, the process which obtains a mother's layered product 17 is not limited to this.

[0035] Namely, as shown in drawing 9 , after forming the laminating sheet 13 which has the ceramic green sheet 12 and the electrode pattern 7 on the support film 11, By repeating the process which forms similarly the ceramic green sheet 24 and electrode pattern 7A further on this laminating sheet 13, the layered product of two or more layers is formed on the support film 11, the laminating of this layered product of two or more layers may be carried out, and a mother's layered product 17 may be formed. In this case, it may change into a ceramic green sheet and a ceramic layer may be formed by applying and stiffening a ceramic paste.

[0036] Drawing 10 is a sectional view for explaining the manufacture approach of the laminating ceramic electronic parts concerning the 2nd example. In the 1st example, although two or more electrode patterns 7 were formed on the ceramic green sheet, as shown in drawing 10 , by the 2nd example, two or more electrode pattern 7C is printed using the gravure roll 1 used in the 1st example on the support film 31 which consists of a synthetic-resin film like a polyethylene terephthalate film first. Also in this case, since it is constituted as the gravure roll 1 mentioned above, electrode pattern 7C may be formed with high precision on the support film 31. The ceramic green sheet 32 is formed so that the field where electrode pattern 7C is formed on the support film 31 may be covered after an appropriate time. Thus, the laminating sheet 33 with which two or more electrode pattern 7C was formed in the inferior surface of tongue of the ceramic green sheet 32 can be obtained. A mother's layered product may be obtained by carrying out the laminating of this laminating sheet 33 with a replica method like the 1st example.

[0037] Or as shown in drawing 11 , after forming the above-mentioned laminating sheet 33 on the support film 31, the process which forms a laminating sheet may be repeated further, electrode pattern 7D and the ceramic green sheet 34 may be formed, and a mother's layered product may be obtained by it.

[0038] Drawing 12 is a transverse-plane sectional view for explaining the modification of the 2nd example. In the 2nd example, after two or more electrode pattern 7C was formed on the support film 31, the ceramic green sheet 32 was formed, but as shown in drawing 12 , after forming two or more electrode pattern 7C, among two or more electrode pattern 7C, a ceramic paste may be printed so that it may become thickness equivalent to electrode pattern 7C, and the compound sheet 41 may be formed. With this compound sheet 41, since the ceramic paste 42 is arranged between electrode pattern 7C, it is supposed that the top face of the compound sheet 41 is flat.

[0039] Therefore, the laminating of the ceramic green sheet 43 is carried out on the compound sheet 41, and further, when a mother's layered product is obtained by repeating ** which carries out the laminating of the compound sheet 41 and the ceramic green sheet, the difference of the thickness of the part which electrode pattern 7C overlaps, and other parts can be reduced. That is, when a mother's layered product is pressurized in the thickness direction in advance of baking, the consistency difference of the part which electrode pattern 7C overlaps, and the part in which electrode pattern 7C is not prepared can be reduced, and generating of delamination can be controlled.

[0040] In addition, like the modification shown in drawing 12 , after forming electrode pattern 7C on a support film, the approach of printing a ceramic paste in thickness equivalent to electrode pattern 7C between the electrode patterns 7 was learned conventionally. However, in a conventional method, when the ceramic paste 121 is printed as shown in drawing 13 since the drag mentioned above in the printing direction back end arises when electrode pattern 7C is formed with gravure, the edge of the ceramic paste 121 will be risen and applied on drag section 122a in the printing direction back end of the electrode pattern

122. That is, if this invention is used for thickness equivalent to an electrode pattern to having been difficult to print a ceramic paste with high precision between electrode patterns when a conventional method is used, since it will drag to the printing direction back end of such an electrode pattern and the section will not arise, a ceramic paste can be printed in thickness equivalent to an electrode pattern with high precision, and the flat laminating sheet 43 can be obtained easily.

[0041] Moreover, also in the 1st example, after forming two or more electrode patterns 7 on a ceramic green sheet, a ceramic paste can be printed in thickness equivalent to two or more electrode patterns 7, a ceramic green sheet layer may be formed so that between two or more electrode patterns 7 may be filled, and a precise sintered compact can be obtained by it like the modification shown in drawing 12 R> 2.

[0042] Although the mark details 2 of the configuration shown in (a) were formed in drawing 1 in the example and modification which have been mentioned above, in this invention, the configuration of the printing section of a gravure roll may deform suitably. Drawing 14 (a) - (c) and drawing 15 are each typical top view showing the modification of the printing section.

[0043] Drawing 14 (a) In - (c) and drawing 15, the printing direction is left-hand side from the right-hand side of a drawing, therefore the right-hand side of a drawing serves as the printing direction front end. In the printing section 51 shown in drawing 14 (a), the frame top crevice 53 is established in the outside of a part in which two or more crevices 52 are established. In the printing section 51, the frame-like crevice 53 has the 2nd part 53b and 53c prolonged in the printing direction back end from the both ends of 1st partial 53a prolonged in the printing direction front end like the printing section 2 in the printing direction and the direction which intersects perpendicularly, and 1st partial 53a. Furthermore, the 53d of the 3rd part is prepared in the printing section 51. It is formed so that the frame-like crevices 52b and 52c of a pair may be connected with the printing direction back end, but the 53d of the 3rd part is extended in the shape of a

straight line in the printing direction and the crossing direction so that clearly from drawing 14 (a). Two or more crevices 52 are enclosed by the frame-like crevice 53 of the shape of such a ring closure.

[0044] In the printing section 51, since the printing direction back end part is constituted by the 53d of the 3rd part of the above-mentioned frame-like crevice 53, the back end of the printing section 51 is made into configurations other than the straight line which intersects perpendicularly with the printing direction. Therefore, on the occasion of printing, a doctor blade cannot bound easily in the printing direction back end, and can print conductive paste in the configuration as a request.

[0045] In the printing section 54 shown in drawing 14 (b), 3rd partial 53e of the above-mentioned frame-like crevice 53 has [therefore] the configuration of the letter of the abbreviation for V characters. Like the printing section 51 the back end of the printing section 54 Since it considers as configurations other than the straight line which intersects perpendicularly with the printing direction, the bound in the printing direction back end of the doctor blade for printing like the printing section 51 can be controlled.

[0046] In the printing section 55 shown in drawing 14 (c), the 53f of the 3rd part of the frame-like crevice 53 has the configuration of the shape of a semicircle projected back. Moreover, in the printing section 56 shown in drawing 15 , it has the configuration of the shape of a semicircle which the 53g of the 3rd part of the frame-like crevice 53 in the printing direction back end projected toward the printing direction front. Thus, in the printing section, especially if the configurations of the 3rd part where it is located in the printing direction back end of a frame-like crevice are configurations other than the straight line prolonged in the printing direction and the direction which intersects perpendicularly, they will not be limited, but they can be made into various configurations.

[0047] In addition, although conductive paste was printed by the ceramic green sheet and the support film on the occasion of manufacture of laminating ceramic electronic parts in the example and modification which have been mentioned

above using the gravure roll 1 mentioned above The above-mentioned gravure roll 1 is applicable to printing of various pastes of not only printing of conductive paste but a glass paste, an adhesives paste, etc. also about a printing hand-ed The printing hand-ed which consists not only of a ceramic green sheet or a support film but of various ingredients and configurations can be used.

[0048] Furthermore, the manufacture approach of the laminating ceramic electronic parts concerning this invention may be widely used for manufacture of various laminating ceramic electronic parts, such as not only the multilayer capacitor mentioned above but a multilayer substrate, an LC filter, a laminating inductor, etc.

[0049]

[Effect of the Invention] Since it is considered as configurations other than the straight line to which the printing direction back end extends in each printing section of a gravure roll in the printing direction and the direction which intersects perpendicularly in printing two or more electrode patterns on a ceramic green sheet using a gravure roll, by the manufacture approach of the laminating ceramic electronic parts concerning the 1st invention, it is hard poor printing, such as the drag of the printing direction back end in the printed electrode pattern, producing.

[0050] Therefore, the electrode pattern according to the printing section can be printed with high precision on a ceramic green sheet, there is little dispersion in electrical characteristics, such as electrostatic capacity, etc., and the laminating ceramic electronic parts which a poor short circuit and poor insulation resistance cannot produce easily can be offered.

[0051] In printing two or more electrode patterns by the manufacture approach concerning the 2nd invention using a gravure roll on a support film Since the printing direction back end of each printing section of a gravure roll outside surface is made into configurations other than the straight line which intersects perpendicularly with the printing direction Since an electrode pattern can be printed with high precision on a support film and it is hard to produce poor

printing like the case of the 1st invention, there is little dispersion in electrical characteristics, such as electrostatic capacity, and the laminating ceramic electronic parts which a poor short circuit and poor insulation resistance cannot produce easily can be offered.

[0052] When carrying out multiple-times formation of the laminating sheet which has a ceramic green sheet and an electrode on a support film and obtaining a mother's layered product, the laminating process which obtains a mother's layered product can be performed on a support film, and the workspace for a laminating can be reduced.

[0053] Moreover, when carrying out the laminating of the laminating sheet supported by the support film with a replica method and obtaining a mother's layered product, even if it is the case where a ceramic green sheet with thin thickness is formed, after having been supported by the support film, a laminating can be carried out to stability.

[0054] In having further the process which forms the ceramic green sheet layer of thickness equivalent to this electrode pattern among two or more printed electrode patterns When a mother's layered product is pressurized in the thickness direction, it is hard to produce the level difference of the part which the electrode pattern overlaps, and the part in which an electrode pattern does not exist. Therefore, a precise sintered compact can be obtained, generating of delamination etc. can be controlled, and the dependability of laminating ceramic electronic parts can be raised.

[0055] A frame-like crevice is not formed in the printing direction and the crossing direction at the printing direction back end of the printing section. When the back end of the printing section is constituted by the printing direction, the back end of the 2nd part of the frame-like crevice which extends in parallel, and the back end of two or more crevices Since the straight line to which the back end of this 2nd part and the back end of two or more crevices extend in the printing direction and the direction which intersects perpendicularly does not become, according to this invention, poor printing in the printing direction back end can be controlled.

[0056] Since it is hard to produce bound of the blade for scratching excessive conductive paste in this 3rd part in having the 3rd part prolonged in the direction in which a frame-like crevice crosses to the direction which intersects perpendicularly with the printing direction in the back end of the 2nd part, according to this invention, poor printing in the printing direction back end can be controlled.

[0057] Since the printing section which has configurations other than the straight line prolonged in the printing direction back end in the printing direction and the direction which intersects perpendicularly is equipped with the gravure roll formed in the outside surface, and the blade which removes an excessive paste, in case the gravure equipment concerning this invention removes an excessive paste with a blade, in the printing direction back end, bound of a blade cannot produce it easily. therefore, highly precise [according to the configuration of the printing section] in a paste -- it can print.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] (a) and (b) are the typical top view expanding and showing the

typical top view for explaining the configuration of the printing section currently formed in the outside surface of the gravure roll used for the manufacture approach of the laminating ceramic electronic parts concerning this invention, and its part.

[Drawing 2] The typical top view showing the configuration of the electrode pattern printed by the printing section shown by drawing 1 (a).

[Drawing 3] The typical transverse-plane sectional view showing the process which removes excessive conductive paste with a blade in the 1st example of this invention while holding conductive paste in the printing section of a gravure roll.

[Drawing 4] The perspective view showing the appearance of the gravure roll used in the 1st example of this invention.

[Drawing 5] The transverse-plane sectional view showing the condition of having formed the ceramic green sheet on the support film in the 1st example of this invention, and having formed two or more electrode patterns on this ceramic green sheet.

[Drawing 6] The transverse-plane sectional view for explaining a mother's layered product obtained in the 1st example of this invention.

[Drawing 7] The transverse-plane sectional view showing the layered product of each multilayer capacitor unit.

[Drawing 8] The transverse-plane sectional view showing the multilayer capacitor obtained according to the 1st example of this invention.

[Drawing 9] The transverse-plane sectional view showing the condition of having carried out the laminating of two or more ceramic green sheet and two or more electrode patterns on the support film, and having obtained a mother's layered product in the modification of the 1st example.

[Drawing 10] The transverse-plane sectional view showing the condition of having formed the ceramic green sheet layer after printing two or more electrode patterns on a support film in the 2nd example of this invention.

[Drawing 11] The typical transverse-plane sectional view showing the condition of

having repeated the laminating process of an electrode pattern and a ceramic green sheet two or more times, in the modification of the 2nd example of this invention.

[Drawing 12] The transverse-plane sectional view for explaining how being drawing for explaining other modifications of this invention, and forming a ceramic green sheet layer among two or more electrode patterns.

[Drawing 13] The partial notching expansion transverse-plane sectional view for explaining the trouble at the time of forming a ceramic green sheet between electrode patterns in the conventional technique.

[Drawing 14] (a) - (c) is each typical top view showing the modification of the configuration of the printing section formed in the gravure roll outside surface of the gravure equipment concerning this invention.

[Drawing 15] The typical top view for explaining other examples of the configuration of the printing section formed in the outside surface of the gravure roll used in this invention.

[Drawing 16] The outline block diagram for explaining the process which carries out gravure of the electrode pattern on a ceramic green sheet on the occasion of manufacture of the conventional laminating ceramic electronic parts.

[Drawing 17] The partial notching sectional view for explaining the process which removes the excessive conductive paste on a gravure roll with a blade in a conventional method.

[Drawing 18] The partial notching top view for explaining a trouble when two or more electrode patterns are printed on a ceramic green sheet according to a conventional method.

[Description of Notations]

1 -- Gravure roll

2 -- Printing section

3 -- Crevice

4 -- Frame-like crevice

4a -- The 1st part

4b, 4c -- The 2nd part
4d -- The 3rd part
5 -- Conductive paste
6 -- Blade
7 -- Electrode pattern
7A, 7C, 7D -- Electrode pattern
11 -- Support film
12 -- Ceramic green sheet
13 -- Laminating sheet
17 -- A mother's layered product
18 -- Layered product
19 -- Sintered compact
20a-20d -- Internal electrode
21 22 -- External electrode
23 -- Multilayer capacitor
31 -- Support film
32 -- Ceramic green sheet
33 -- Laminating sheet
42 -- Ceramic paste
51, 54, 55, 56 -- Printing section
52 -- Crevice
53 -- Frame-like crevice
53a -- The 1st part
53b, 53c -- The 2nd part
53d-53g -- The 3rd part

[Translation done.]

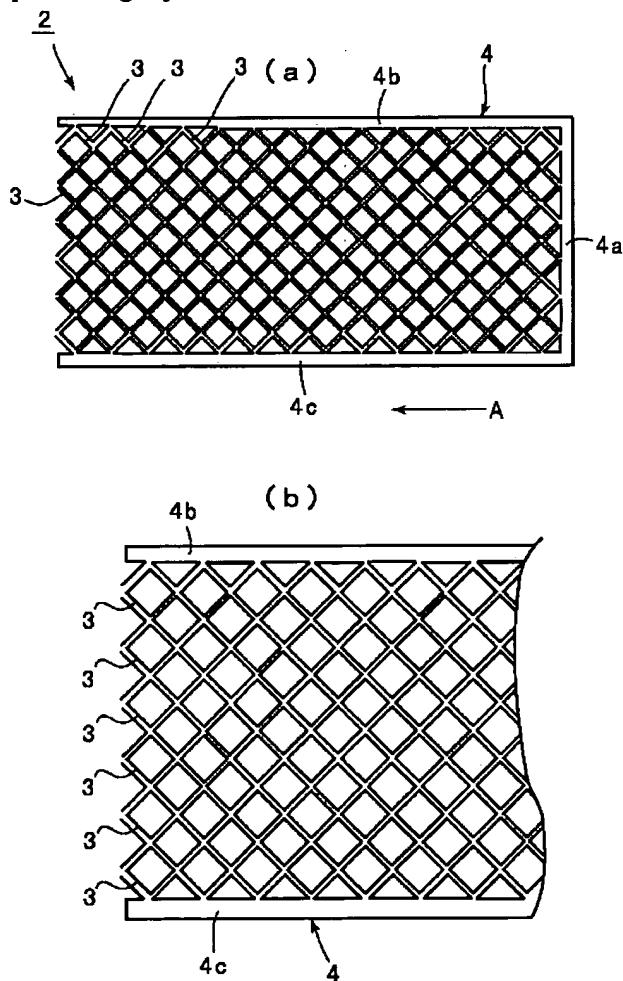
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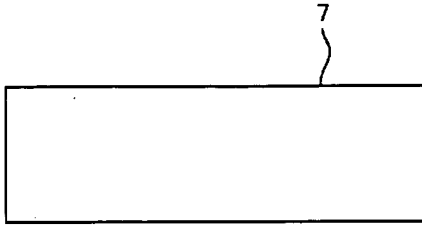
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DRAWINGS

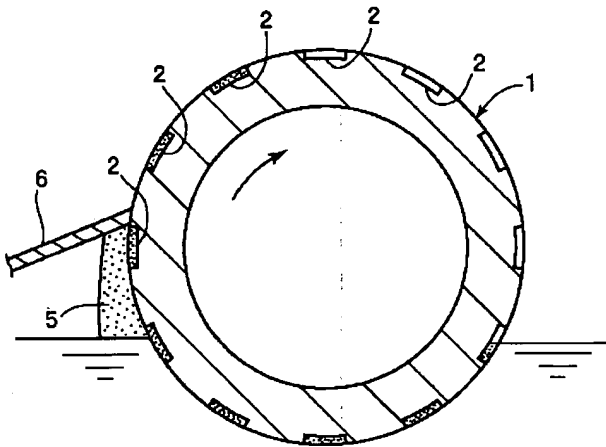
[Drawing 1]



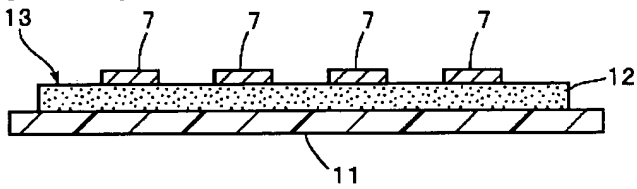
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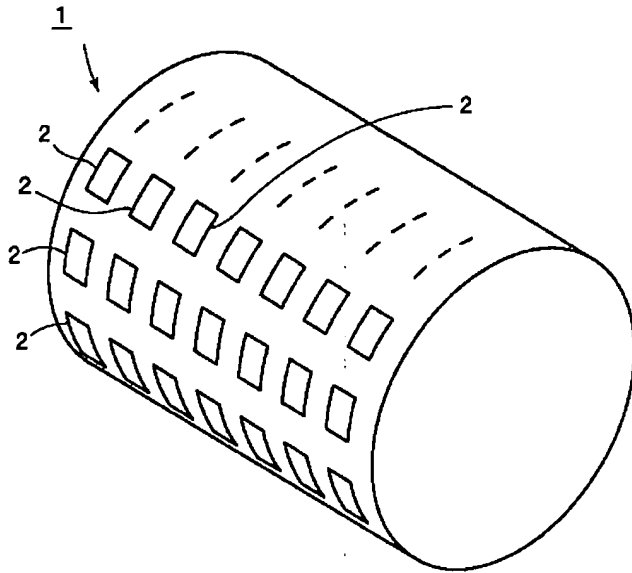
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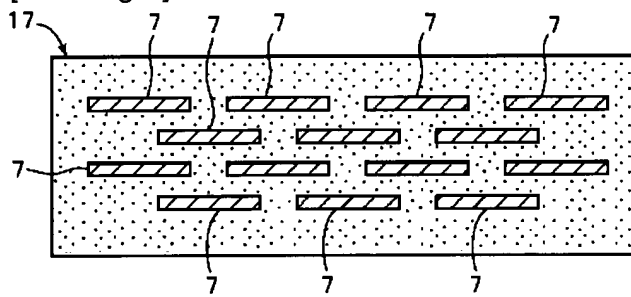
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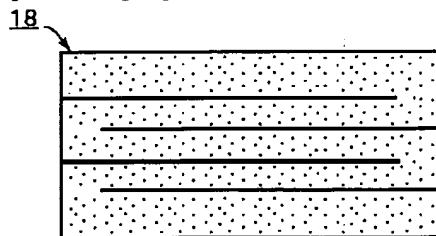
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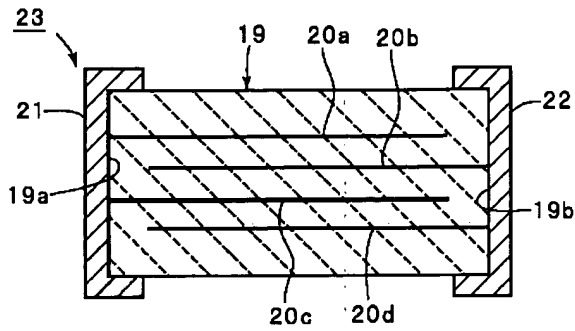
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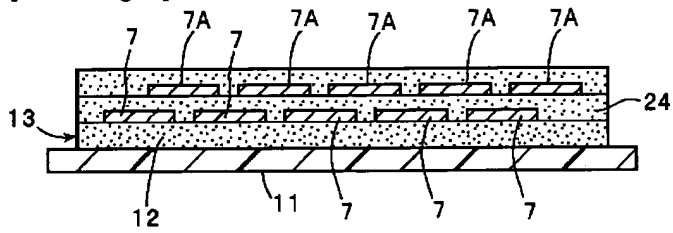
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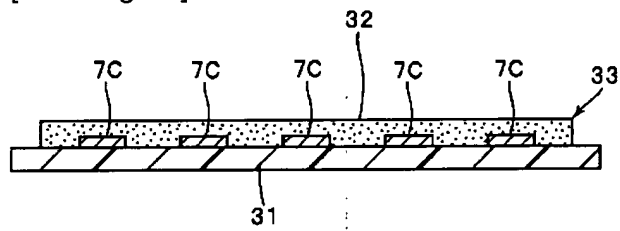
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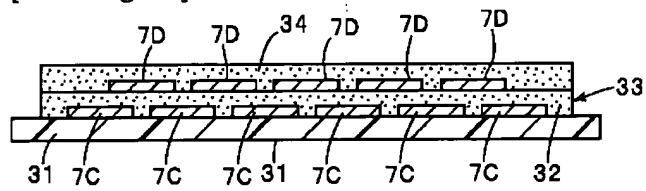
[Drawing 9]



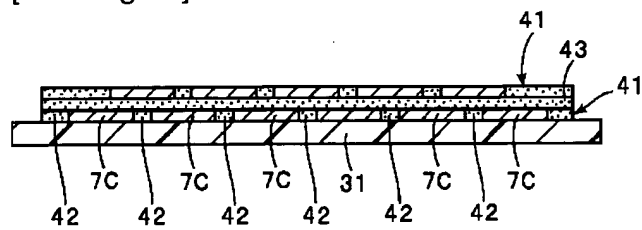
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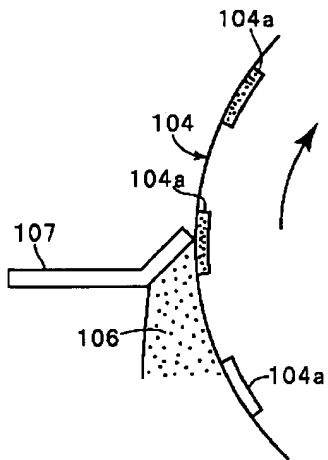
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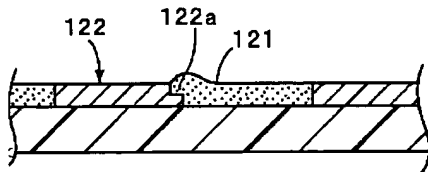
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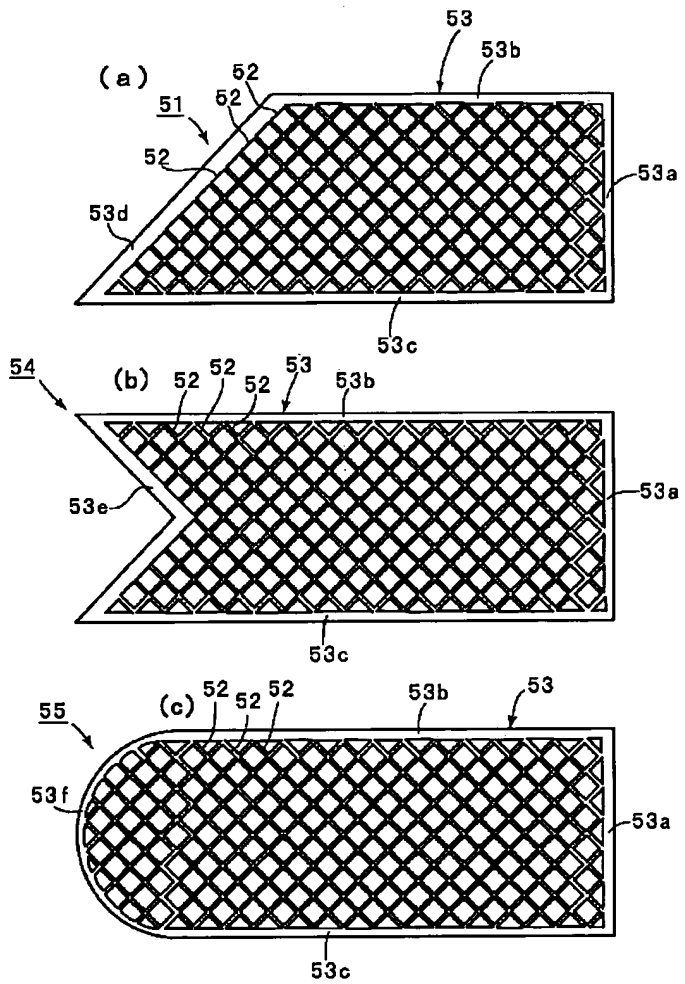
[Drawing 17]



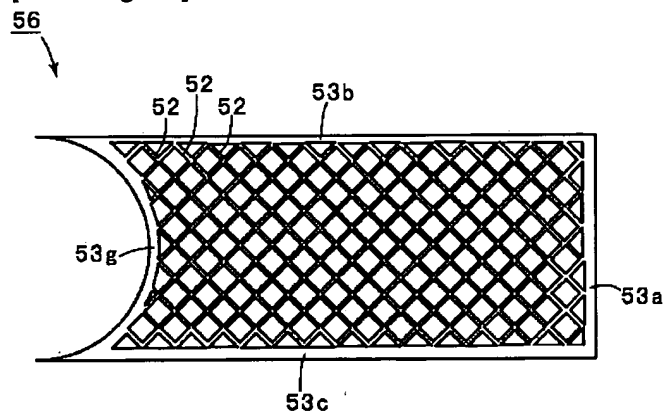
[Drawing 13]



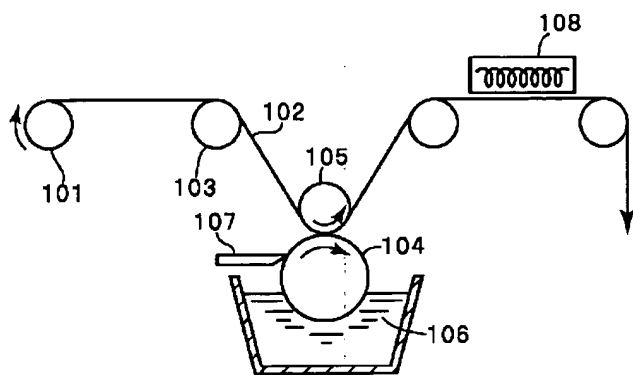
[Drawing 14]



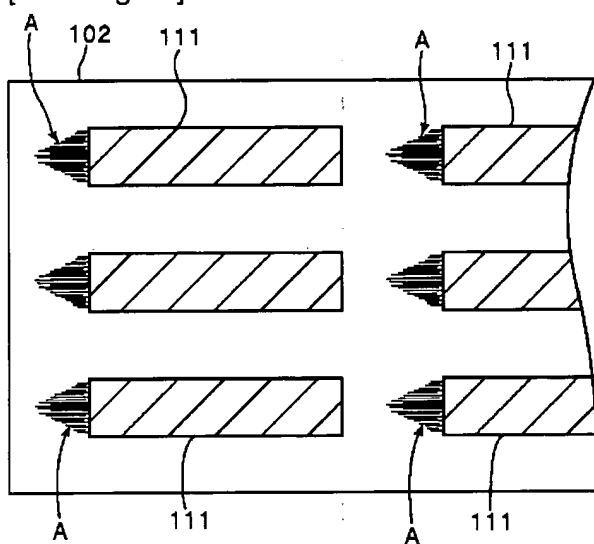
[Drawing 15]



[Drawing 16]



[Drawing 18]



[Translation done.]